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Lumbard

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[54] **CLOSED-MOLD FOR LED ALPHANUMERIC DISPLAYS**

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[73] Assignee: **Siemens Microelectronics, Inc.**, Cupertino, Calif.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

[21] Appl. No.: **579,535**

[22] Filed: **Dec. 27, 1995**

[51] **Int. Cl.**[6] **B29C 39/28**

[52] **U.S. Cl.** **425/116**; 425/121; 264/272.14; 264/272.17

[58] **Field of Search** ..... 425/121, 116, 425/544, DIG. 228, 567, 574, 117; 264/272.17, 272.14; 29/588

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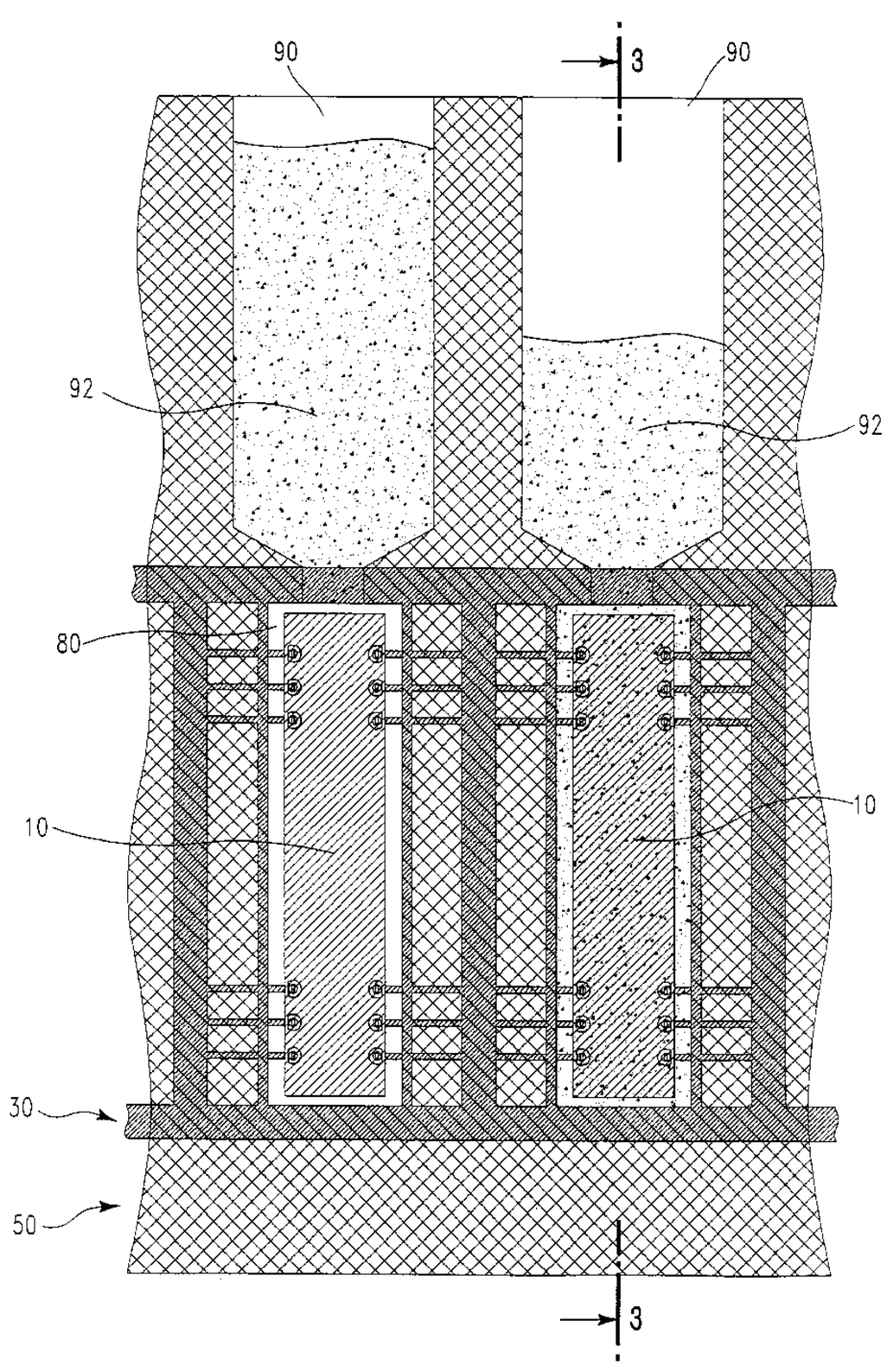
[57] **ABSTRACT**

A closed mold for encapsulating LED alphanumeric display devices uses opposing platens and top and bottom plates to achieve a seal about the display device. By providing the display device with a dambar, splatter on the leads is avoided.

5 Claims, 5 Drawing Sheets



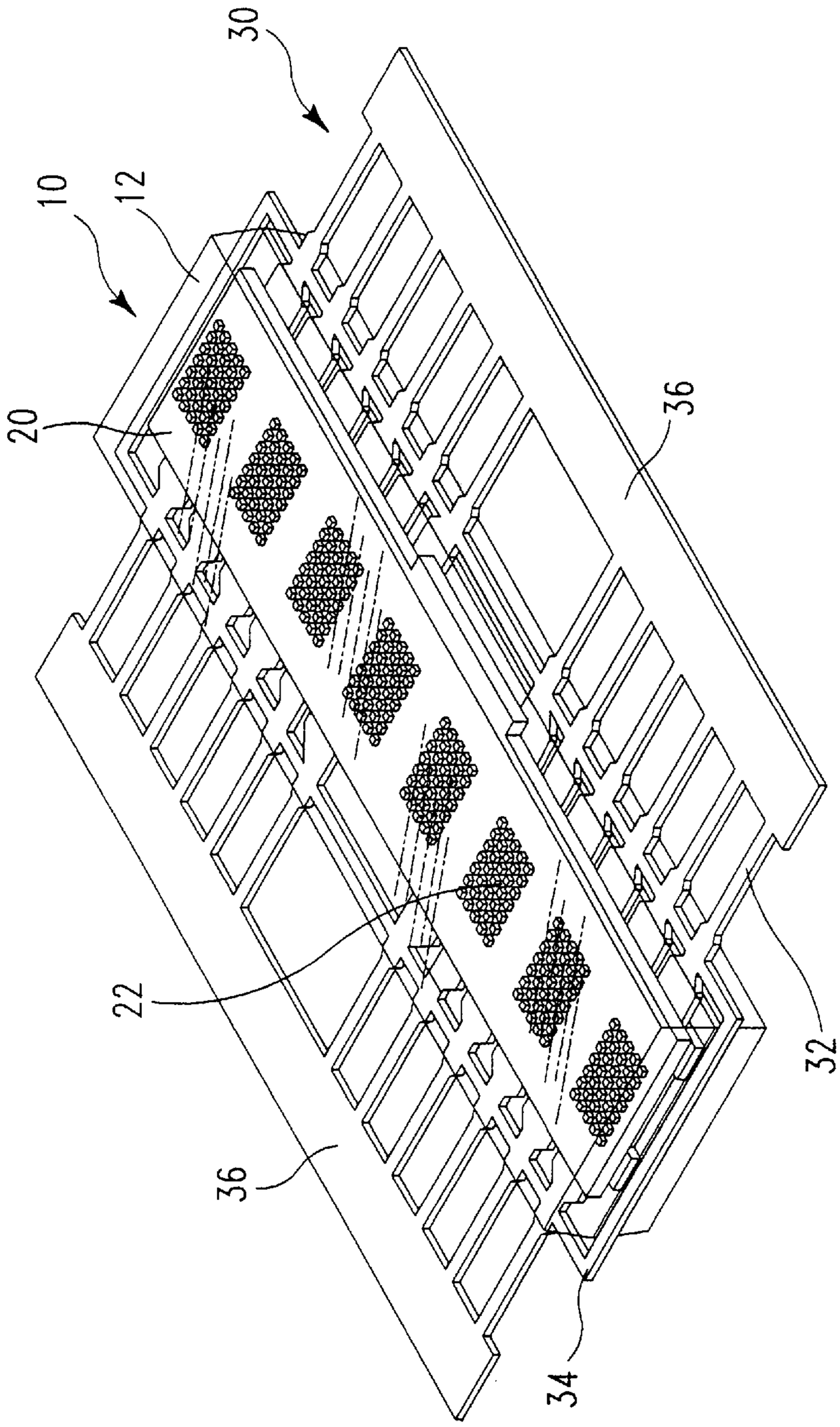


FIG. 1

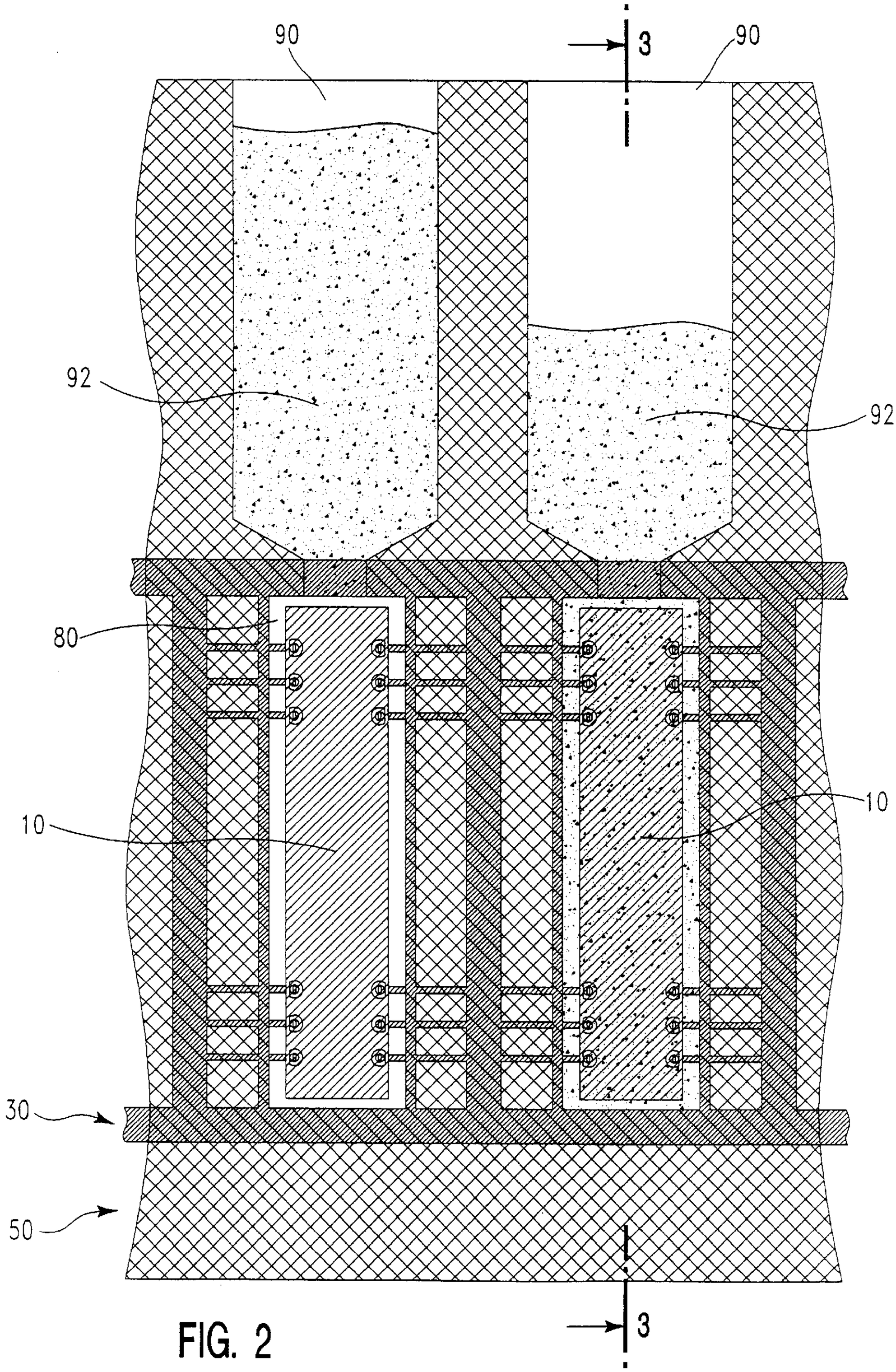


FIG. 2

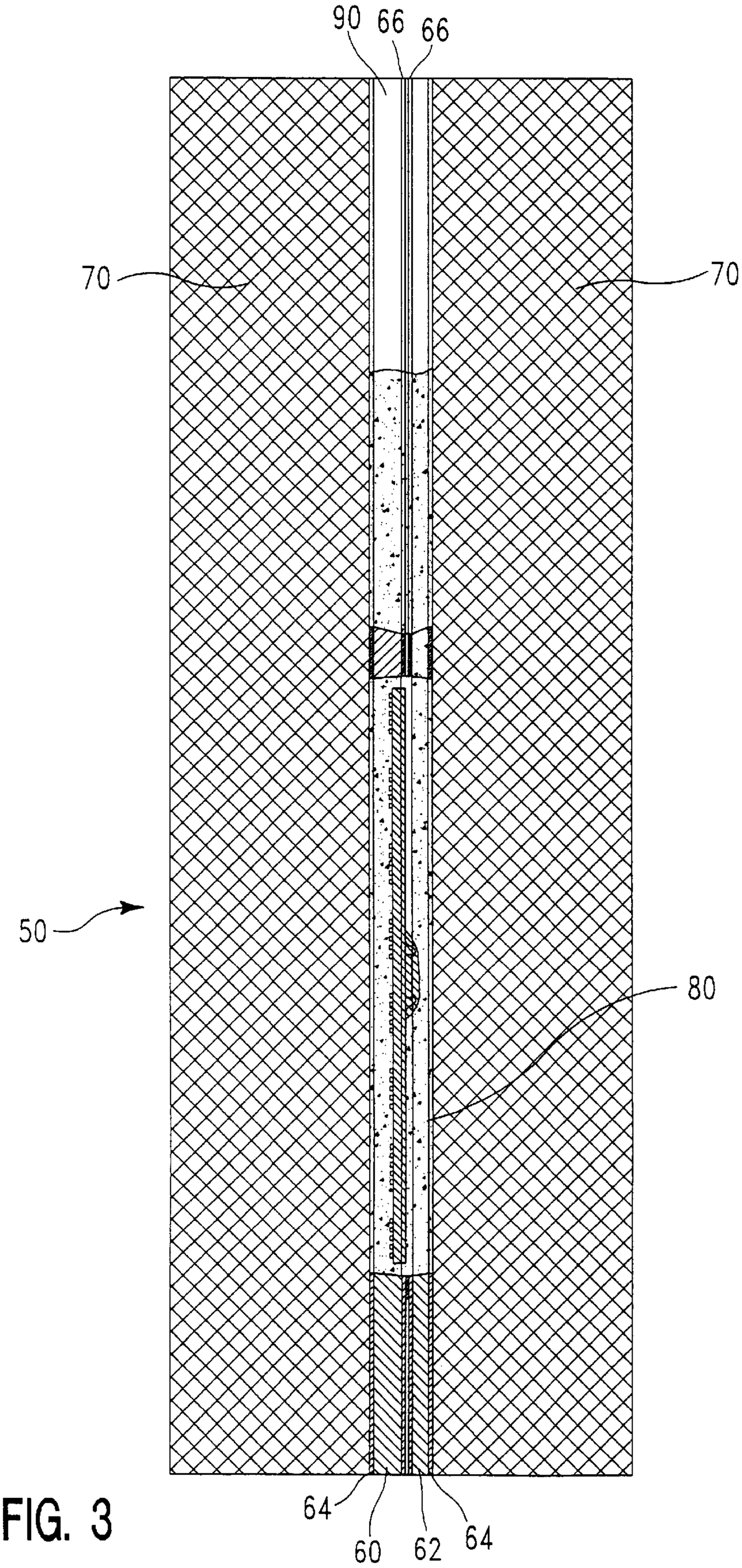


FIG. 3

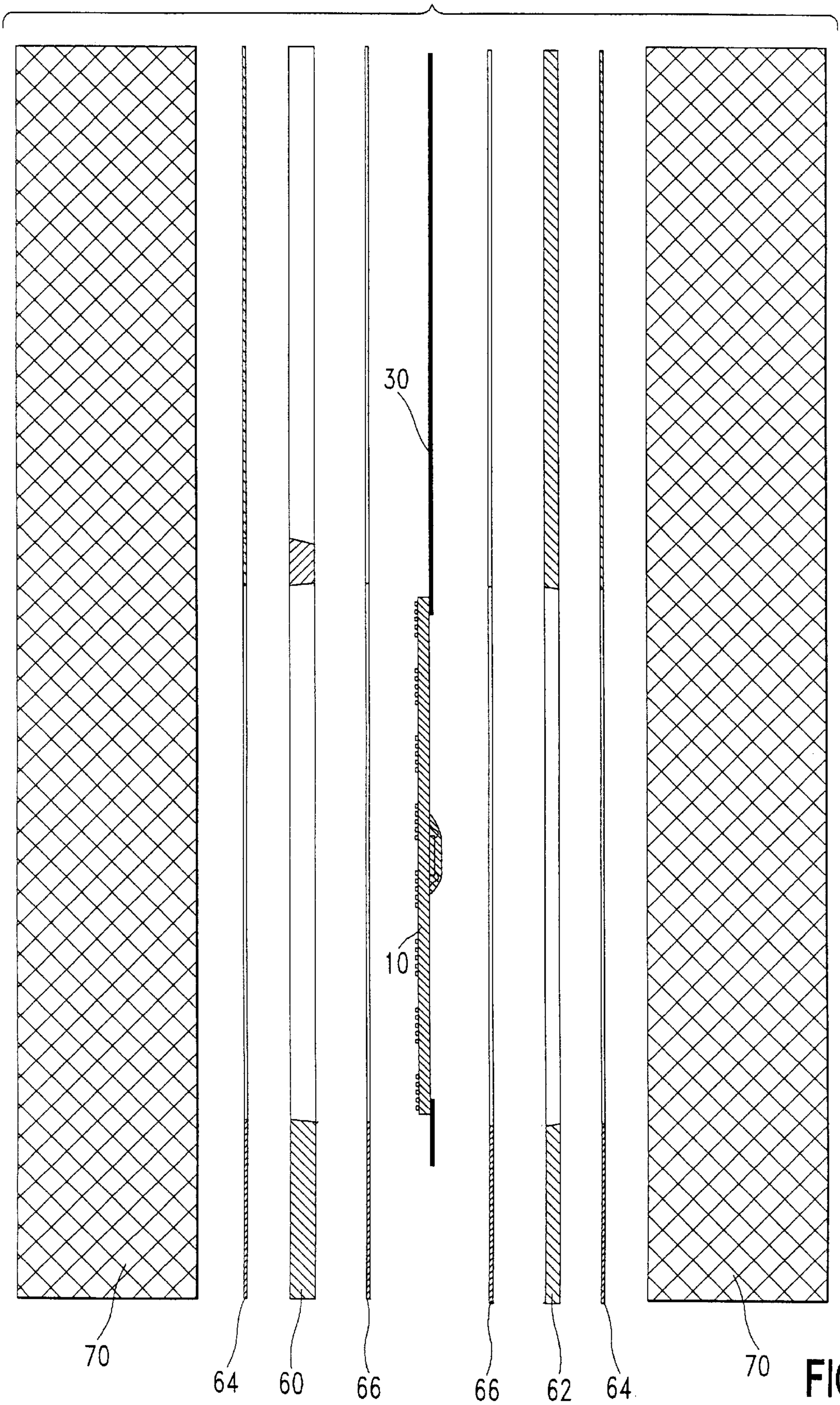


FIG. 4

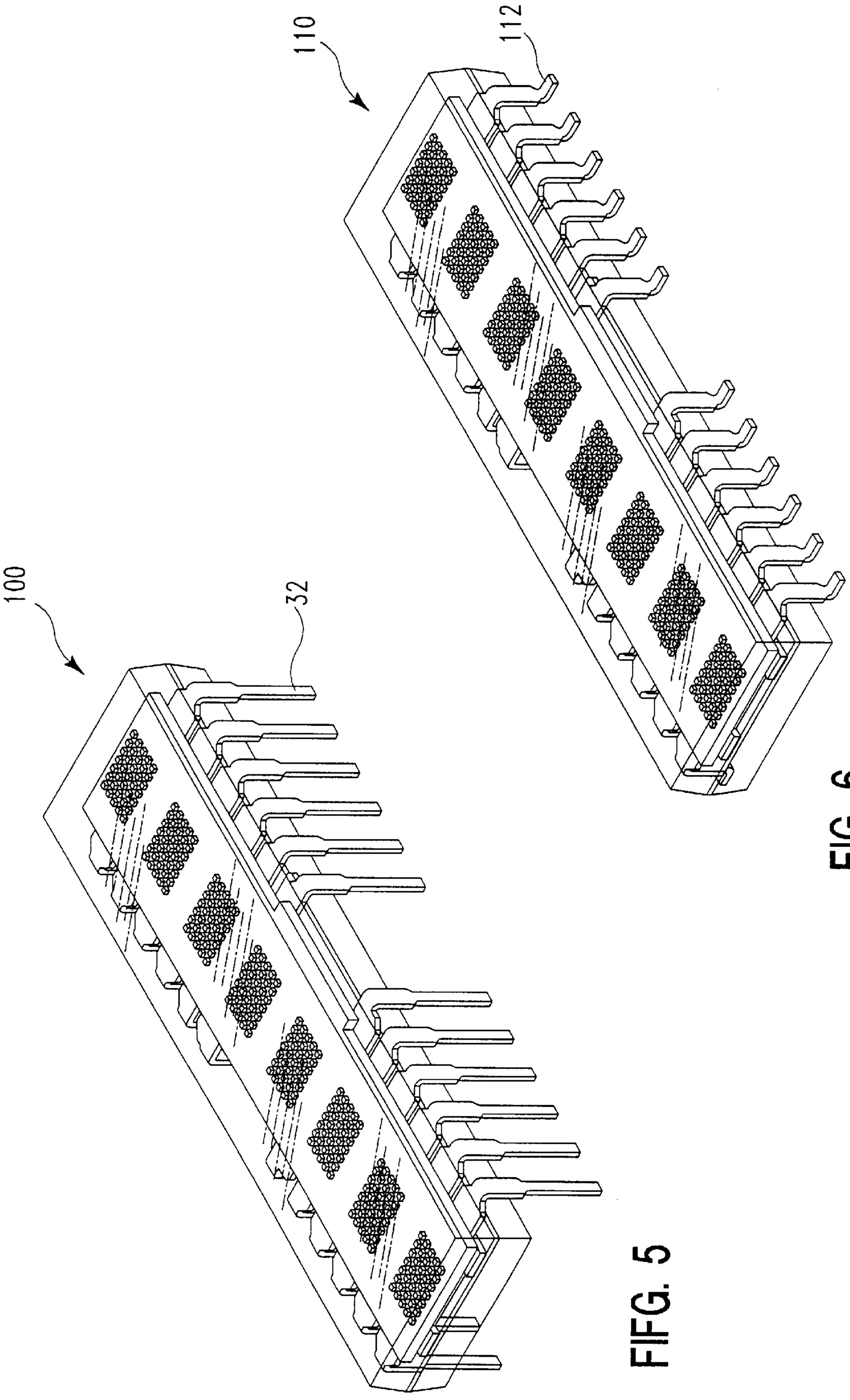


FIG. 5

FIG. 6

CLOSED-MOLD FOR LED ALPHANUMERIC DISPLAYS

FIELD OF THE INVENTION

This invention generally relates to LED alphanumeric displays. Specifically, the invention is directed to a scheme for packaging an LED alphanumeric display.

BACKGROUND OF THE INVENTION

For certain applications, a surface-mount or a gull-wing type lead configuration is preferred for an LED alphanumeric display package. The foundation for a display with this kind of lead configuration is an axial-cast printed circuit board encapsulated in epoxy in a vacuum mold. However, in producing such a device, one may encounter gas bubbles and pockets that form in the epoxy as the epoxy enters the cavity of the mold. Bubbles or pockets in the epoxy can affect the appearance and performance of a display. Another difficulty that may occur is splatter of epoxy on the leads, which could interfere with the electrical and mechanical integrity of the leads. If epoxy does get on the leads, a time-consuming and costly cleaning step is required.

It would be desirable to provide a means and a method of encapsulating the display to avoid the difficulties noted above.

SUMMARY OF THE INVENTION

The present invention obviates the aforementioned problems by providing a closed mold of opposing platens for encapsulating an electrical device, such as, an LED alphanumeric display. The device to be encapsulated is set in an axial-leaded leadframe that has a peripheral dambar to prevent epoxy from getting on the leads. Improved flow of epoxy in the cavities of the mold is provided by funnels formed by the opposing platens of the closed mold.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the invention, reference is made to the following description of an exemplary embodiment thereof, and to the accompanying drawings, wherein:

FIG. **1** is a perspective view of an LED alphanumeric display employing an axial-leaded leadframe;

FIG. **2** is a partial cross-sectional view of a closed mold of the present invention;

FIG. **3** is a cross-sectional end-view of the closed mold of FIG. **2** taken along lines A—A;

FIG. **4** is an exploded cross-sectional view of the closed mold of FIG. **3**;

FIG. **5** is a perspective view of an encapsulated LED alphanumeric display with leads configured for through-board insertion; and

FIG. **6** is a perspective view of an encapsulated LED alphanumeric display with gull-wing type leads configured for surface mounting.

DETAILED DESCRIPTION

FIG. **1** shows an LED alphanumeric display assembly **10** encapsulated in epoxy **12** before trimming of the leadframe. In this illustration, the display assembly **10** has a printed circuit board **20** generally rectangular in shape and containing display elements **22** and an axial-leaded leadframe **30**. The leadframe has multiple leads **32**, a peripheral dambar **34**, and temporary support members **36**. The dambar **34** encompasses the circuit board **20** and is removed along with the temporary support members **36**.

For encapsulation in epoxy, the display assembly **10** is encapsulated in a closed mold **50** as illustrated in FIGS. **2–4**. In FIG. **2**, two display assemblies **10** are shown suspended in a leadframe **30**. The leadframe **30** is held between two plates, a top mold plate **60** and a bottom mold plate **62**, as illustrated in FIG. **3**, located on opposing flat polished platens **70**.

The top and bottom mold plates **60** and **62** define mold cavities **80**, which are selected here to be slightly larger than the dimensions of the printed circuit board **20** and ultimately determine the dimensions of the encapsulated devices. To improve the sealing of the mold as well as decrease the pressure needed to create a seal, one may provide 0.010 inch-thick silicone gaskets **64** between the plates **60** and **62** and the platens **70**. Additionally, gaskets **66** can be provided on each of the opposing surfaces of the plates **60** and **62**, as shown in FIGS. **3** and **4**.

The platens **70** also form epoxy supply funnels **90** spaced apart so that they coincide with each mold cavity **80**. In a preferred embodiment, the cross-sectional area of the entrance aperture is greater than the cross-sectional area of the exit aperture and the cross-sectional area is monotonically non-increasing from the entrance aperture to the exit aperture. Epoxy is then poured into the funnels **90**. Alternatively, the funnels **90** can be wholly contained located within one or the other of the opposing plattens **70**.

To encapsulate a display assembly **10**, the assembly **10** is placed between the top and bottom mold plates **60** and **62**, and the mold **50** is closed and sealed. Minimal pressure is required to maintain the seal. The mold **50** is then placed in a vacuum chamber and a vacuum of, e.g., 1 torr is pulled.

Pre-degassed epoxy **92** is then rapidly dispensed into the individual funnels **90**, in a relatively steady flow to avoid sheeting or bubbling. The amount of epoxy required for encapsulation is approximately one-and-one-half the volume of the display printed circuit board **20**. The vacuum is then cracked, forcing the epoxy into the evacuated mold cavities **80**, intentionally leaving excess epoxy **92** in the funnels **90** after the mold cavities are filled. The epoxy is then cured, the overfill is removed, the dambar **34** is trimmed and the leads **32** are formed, completing the display device.

A display assembly **100** have leads **32** trimmed and configured for a through-board application is shown in FIG. **5**. A display assembly **110** with a gull-wing lead configuration **112** is illustrated in FIG. **6**.

The embodiments described herein are merely illustrative of the principles of the present invention. Various modifications may be made thereto by persons ordinarily skilled in the art, without departing from the scope or spirit of the invention.

What is claimed is:

1. A closed mold for encapsulating a device with epoxy, comprising:

two opposing platens, and

a top mold plate and a bottom mold plate, each of the mold plates being affixed to one of the opposing platens, the opposing platens and the mold plates together defining at least one mold cavity and at least one epoxy supply funnel for the introduction of epoxy into the mold cavity using a vacuum-mold process, the supply funnel having an entrance aperture and an exit aperture wherein the cross-sectional area of the entrance aperture is greater than the cross-sectional area of the exit aperture and the cross-sectional area is

monotonically non-increasing from the entrance aperture to the exit aperture, wherein the mold cavity is connected to the exit aperture of said supply funnel.

2. The apparatus as set forth in claim **1**, further comprising a gasket positioned between each of the mold plates and the platens.

3. The apparatus as set forth in claim **2**, wherein the gasket is silicone.

4. The apparatus as set forth in claim **1**, wherein the device to be encapsulated has a peripheral dambar, said top and bottom mold plates and said dambar in combination comprising a seal for the mold cavity.

5. A closed mold for encapsulating a device with epoxy, comprising:

two opposing platens, and

a top mold plate and a bottom mold plate, each of the mold plates being affixed to one of the opposing platens, the opposing platens and the mold plates together defining at least one epoxy supply funnel for the introduction of epoxy into a mold cavity using a vacuum-mold process, wherein the mold cavity is connected to the exit aperture of said supply funnel, and wherein the device to be encapsulated has a peripheral dambar, said top and bottom mold plates and said dambar in combination comprising a seal for the mold cavity.

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